IMPACT OF PLASTIC POLLUTION ON THE ENVIRONMENT OF DIFFRENT LAKES AND PARKS OF DHAKA CITY

By

TASNIA TASNIM TALUKDER

ID: 181-30-181

This Thesis Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science (B.Sc.) in Environmental Science and Disaster Management (ESDM)

Supervised by:

Dr. Mahfuza Parveen, PhD

Associate Professor

Department of Environmental Science and Disaster Management

Daffodil International University

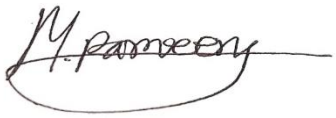
DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

JANUARY 2022

APPROVAL

This thesis report titled **"Impact of plastic packaging and short-term plastic usability on environment"**, submitted by Tasnia Tasnim Talukder to the Department of environmental Science and Disaster Management (ESDM), Daffodil International University (DIU), has been accepted as satisfactory for the partial fulfillment of the degree of Bachelor of Science (B.sc) in Environmental Science and Disaster Management (ESDM) and approved as to its style and contents.



Dr. Mahfuza Parveen, Ph.D.

Associate Professor

Department of Environmental Science and Disaster Management

Daffodil International University

DECLARATION

I hereby declare that this research project has been done by me under the supervision of Dr. Mahfuza Parveen, Ph.D., Associate Professor, Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU). I also declare that neither this research project nor any part of this research project has been submitted elsewhere for the award of any degree.

Tasnia Tasnim Talukder

ID: 181-30-181

Department of Environmental Science and Disaster Management (ESDM)

Daffodil International University

DEDICATION

To,

my loving parents

MD. Moudud Talukder Sahin

Lovely Talukder

my elder sister

Badrunnesa Talukder

my respected teachers

Dr. A. B. M. Kamal Pasha, DSc.

Dr. Mahfuza Parveen, PhD

Md. Azharul Haque Chowdhury

Md. Sadril Islam khan

S M Mahmudur Rahman

and

to the loving memory of my beloved seniors, juniors, coordination officers and staffs from the Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU) with whom I was spent a single second of my undergrad life.

ACKNOWLEDGEMENT

I would like to express my deepest appreciation for my research supervisor, Dr. Mahfuza Parveen, Ph.D. (Associate Professor, ESDM, DIU), Advisor Md. Azharul Haque Chowdhury (Senior lecturer, ESDM, DIU) & my honorable department head, Dr. A. B. M. Kamal pasha, D. Sc. (Associate professor) for introducing me to about the research Impact of plastic packaging and short-term plastic usability on environment and for supporting all of my endeavors in single use plastic. I would not have been able to complete my thesis or degree without their guidance and support. I am very thankful to Sagar Mozumder (Alumni, ESDM, DIU) for his assistance, support, guidance and suggestions to conducting this complete research. Also, I am very grateful to my beloved seniors, batch mates who helped me and supported me from the beginning to the end of this study.

I thanked the Department of Environmental Science and Disaster Management (ESDM), Daffodil International University and our honorable Dean, department head, faculty members, staffs, without their little contribution, I may not be here, today.

Finally, I am thankful to my family my parents for supporting my research interest in the field of Environmental Science thought out this endeavor. I would not have been able to complete my thesis without their support and encouragement.

ABSTRACT

The use of one-time plastics is growing at an unusual rate. Plastic products that are no longer used or discarded after use are known as one-time plastics. Many types of one-time plastic products are now easy to catch. These include plastic cups, spoons, straws, plates, glasses and many more types of one-time plastic products. These one-time plastic products are mostly coming from places like restaurants, residential hotels, airlines, super shops, tea shops and special events.

The use of plastic is essential today because of our daily survival. Polymer is being used as an alternative material in every field of life. Plastic is being used as an alternative to everything from carry bags to medicine bottles, food containers to flower tubs - whether its burlap bags or glass vials or porcelain dishes or earthen tubs. Due to lack of awareness among the common people, they are throwing away the used plastic materials Since the plastic material does not mix with the soil, some of it is not recyclable, so it is gradually accumulating as waste in the local bosom. And pollution is spreading from that. Burning polymer materials is even more dangerous, as hydrocarbons are released into the air, increasing the level of pollution.

About 50 percent of the total plastics produced at present are disposable. In 1990, the amount of plastic used in Bangladesh was only 15,000 metric tons whereas in 2018 it has increased to 1200000 metric tons. The country currently imports about 8 lakh metric tons of raw materials for making plastics. Less than 20 percent of recycled plastic is now being used to make plastic products in Bangladesh. Observations, interviews and questionnaire analysis show that the plastics we use and leave behind in the open are creating barriers in various fields on the one hand and increasing environmental and health risks on the other. This article focuses on eco-friendly processing methods and the proper use of manufactured products as well as the various stages of processing and environmental and health awareness. Finally, we made some recommendations on how to reduce the use of single-use plastic and recent status of biodegradable plastic items manufacturing industries in Bangladesh.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES (IMAGE, MAP AND FLOW CHART)

CHAPTER 1: INTRODUCTION

The worldwide environment is changing day by day, and presently it has ended up a challenge to living life shapes due to the exceptionally revolting truth that each country is attempting to develop their nations without taking into thought of natural effect of corruption and pollution of agricultural lands. Increasingly manufacturing plants are being consistently built up and harmful chemicals and materials are being utilized within the generation handle. Individuals are using plastic packs, which are ecologically perilous items, for their day by day needs basically for shopping purposes as a result of which, the environment and agrarian lands are thereby being contaminated. In this manner, in an endeavor to decrease the natural as well as agricultural land contamination, buyers of plastic sacks and the trade organizations together can play a great part. **(Jalil, Mian and Rahman, 2013).** The plastic generation is anticipated to gotten to be twofold within another 20 years a long time and nearly fourfold by 2050 based on current patterns. It is additionally expected that by 2050 there will be more plastic in our seas than fish (WEF, 2019). All-inclusive, as it was nine percent of all plastic squander ever delivered has been reused. Almost 12 percent has been burned, whereas the remaining 79 percent has amassed in landfills, dumps or the characteristic environment. **(De, 2020).**

Although the first commercial application and large-scale manufacture date back to the 1950s, plastic has become an inseparable component of human progress**. (Hossain et al., 2021).** Nowadays, polythene bags are coming back to the market in different looks. In addition, a wide range of packaging and plastic bottled products (such as mineral water and soft drink bottles, including hotel-restaurant disposable dishes, bowls, cups, glasses) are flooding the market. The use of these materials is increasing at an alarming rate day by day. Drainage, river-ditches, canals-beels are filling-up, land is becoming unsuitable for cultivation, and it is having a negative impact on the environment. We need to move forward now to control the use of packaging and plastic bottled products that are harmful to public health and the environment. Because with the change of time our habits are also changing. When you go to the market, you can see that all the daily necessities are

wrapped in shiny wrappers. We are looking at all these glamorous wrappers and buying without considering the quality and quantity of the product.

1.1. Background:

Plastic has clear advantages. The material is inexpensive, lightweight, and simple to work with. Plastic manufacture has exploded in the last century as a result of these properties. As global plastic output soars over the next 10 to 15 years, this tendency will continue. Unless we rethink how we create, utilize, and manage plastics, we may soon be unable to cope with the quantity of garbage we generate. **(Giacovelli, 2018)**. Plastic pollution has become a widespread environmental problem that has gotten a lot of attention in recent years. Since the 1950s, when large-scale plastic manufacture began, plastic production has grown at an incredible rate, outpacing other man-made materials. **(Van Rensburg, S'phumelele and Dube, 2020).** Governments face a difficult issue in reducing the manufacture and use of single-use plastic bags. Despite the many benefits of plastic and its widespread use, single-use plastic bags cause lasting environmental damage. **(Ali et al., 2021).**

1.2. Problem Statement

Even under modest rains, Dhaka, Bangladesh's main city has been inundated throughout the previous decade. One of the primary causes of this problem is the free flow of polythene shopping bags, which clog the municipal drainage system. As a result, polythene bags have been prohibited in Dhaka City from January 2002. **(Ahmed and Gotoh, 2005).**

1.2.1. Human health effects of plastic

Human wellbeing dangers from plastics can stem from their monomeric building squares, their added substances or from a combination of the two. There are a few poisonous materials which are emitted by plastics. We focus on plastics components and additional compounds of critical concern, such as Bisphenol A and phthalates, among them. Bisphenol A (BPA) is best known as the monomeric building piece of polycarbonate plastics. It was to begin with synthesized in 1891 and utilized habitually as an added

substance to other plastics such as polyvinyl chloride (PVC). **(Proshad et al., 2018).** The yearly yield of BPA within the around the world was 2.2 million metric tons in 2003. A sizable division of this mass comes into contact with nourishment. BPA particles might be expelled from refreshment and nutrition holders into drink and nourishment over time since the polymerization of BPA leaves a few monomers unbound. The filtering prepare is quickened by rehashed washing of containers and when putting away within the acidic or essential things that break down the polymer. As a result, BPA-containing products such as reusable water bottles, infant bottles, and the inner linings of food cans are known to leach the controversial monomer into food over time, especially at high temperatures. **(Kang, Kito and Kondo, 2003).** Food and drinks stored in such containers, including the ubiquitous clear water bottles hanging from just about every hiker's backpack, have been shown to contain a tiny amount of Bisphenol A (BPA), which may interfere with the body's normal hormonal message system, according to studies. The primary sources of BPA exposure in the human body are food and inhalation. Because it is a mimic of the reproductive hormone 'estrogen,' BPA is classified as a hormone. BPA has been linked to a variety of health issues, including ovarian chromosomal damage, lower sperm production, fast puberty, rapid immune system alterations, diabetes, cardiovascular disease, obesity, and more. According to certain research, BPA raises the chance of breast cancer, prostate cancer, aches, metabolic abnormalities, and other diseases. **(Proshad et al., 2018).**

1.2.2. Plastic Pollution's Impact on the Environment

Plastic materials are widely used in a variety of industries, including packaging, consumer goods and domestic uses, construction, textiles, transportation, and electrical and electronic equipment. However, only a small percentage of the plastic materials created are recycled, and the remainder is either incinerated or dumped in landfills or the natural environment. **(Haque et al., 2021).** According to recent data, just around 9% of the approximately 6,300 Mt of garbage created worldwide between 2005 and 2015 was recycled, 12% was burnt, and over 79 percent was sent to landfills or natural environments. Bangladesh is no different from the rest of the world when it comes to the destiny of plastic garbage. Most used plastic items in our county are thrown after their

initial use, and they end up in roads, drains, canals, rivers, and roadside open dumps owing to poor management. This is causing damage to the environment day by day. **(Hossain et al., 2021).**

1.2.3. Plastic Bags' Effects on Agriculture

Plastic bags have a significant detrimental influence on agricultural areas across the world. People are oblivious of the need of recycling plastic bags, so they dump them anywhere as and when they choose. As a result, these wasted plastic bags will inevitably end up in agricultural fields, intermingled with other degraded materials. Because plastic bags do not disintegrate in the soil, they linger on agricultural fields and obstruct the growth of agricultural plants. Plastic bags have the intrinsic quality of preventing crop roots from piercing them in order to travel about the soil in search of natural nutrients, notwithstanding their thinness. As a result, plastic bags have harmed the growth of agricultural products significantly. Plastic bags have the following detrimental effects on agriculture: decreased soil fertility, decreased nitrogen fixation, massive loss of nutrients in the soil, decreased crop harvest, discrepancy in flora and fauna on the soil, and so on. Plastic bags' negative effects affect soil fertility to a large amount, resulting in a significant reduction in agricultural yield. **(Jalil, Mian and Rahman, 2013).** The seepage of harmful chemicals into a groundwater and the ecosystem, particularly in the soil, releases harmful compounds. Pseudomonas, nylon-eating bacteria, and Flavobacteria are polymer and nylon degrading bacteria that contribute to the release of methane gas from the breakdown of nylon, which contributes to greenhouse gas emissions and a global warming. **(Ganguly, 2018).**

1.2.4. Impact of Marine Ecosystems

Small fish commonly eat plastic pellets, which increases their mortality rates, according to feeding studies using plastic pellets. Floating plastic waste, such as fishing gear, has been discovered to be a navigational hazard, resulting in the death or damage of marine species, clogging water intakes, and interfering with ship propellers. Early studies, in response to increased public awareness of stranded plastic trash on beaches, discovered that the regular retention rate of containers and other different bottles differed across

different beaches, and that plastic bottles lasted longer on beaches than non-plastic bottles. The tourist sector is both a substantial contributor to and a primary source of ocean plastic trash. The presence of ocean plastic litter might demoralize some beach-goers, resulting in lower tourist attendance, which can lead to employment and economic losses in the tourism industry. When examined in perspective of future generations' well-being and their need for quality seafood, the potential effects of marine pollution identified in this contribution become even more apparent. The focus of the debate so far has been on identifying sources of marine plastic litter, as well as mounting evidence of the prevalence of plastic litter in the open ocean, on land, and on the shorelines of even the most distant islands. The level of plastic litter in the maritime environment has undoubtedly risen over time, given the slow development in plastic recycling rates compared to the stratospheric expansion in plastic manufacturing. **(Issifu and Sumaila, 2020).**

1.3. Objectives

- To gather people's opinion based on the plastic pollution.
- To identify the type of plastic discharging in Dhanmondi Lake, Suhrawardy Udyan, Chandrima Udyan, Hatirjheel Lake.
- To identify the plastic pollution impact on environment.

CHAPTER 2: LITERATURE REVIEW

2.1. Plastic Material Classification

2.1.1. Type 1: Polyethylene terephthalate or stomach plastic

Disposable water bottles are typically made from stomach plastic. Aside from that, stomach plastics are used to produce various utensils or containers for juice, soft beverages, butter, salad dressing, vegetable oil, mouthwash, cosmetics, and so on. The stomach weight is made of a thin, translucent, and smooth plastic. The stomach is particularly popular among plastic water and other food packing because it is entirely liquid and anti-inflammatory. The stomach material was antiair, preventing oxygen from entering. Drinking or liquids are difficult to wash out of stomach bottles. Although plastic bottles do not contain hazardous bacteria or thalates, they are utilized in the production of antimony trioxide. In the human body, antimony behaves as a potential carcinogen. Long periods of contact with drinking water cause antimony to be expelled from the container. Antimony excretion is more likely as long as the beverage is in touch with the container. The usage of long-term heat was discovered in the investigation to be harmful antimony from the stomach bottle. As a result, it's critical to keep these stomach bottles away from extreme heat. It's worth noting that type 1 or stomach plastic is only meant to be used once (one time use only). In the 'once used' field, the stomach bottle is quite safe. **(Proshad et al., 2018).**

2.1.2. Type 2: High-density Polyethylene

HDPE goods are regarded as extremely safe since they prevent chemical contamination of food. Because of their lightweight, super-strong, long-lasting, weather-resistant, and impact-resistant qualities, these materials are becoming more popular these days. HDPE materials are used to make a variety of everyday items such as oil, milk, conditioners, shampoos, detergent, and soap containers. Because of health concerns, it is not acceptable to reuse an HDPE bottle to store food or drink. These items are commonly recycled into detergent bottles, flower pots, and garbage cans, among other things**. (Hossain et al., 2021).**

2.1.3. Type 3: Low-density polyethylene

A translucent or opaque 'heat-resistant' polymer manufactured of type 3 plastic petroleum. Low-density polyethylene is both flexible and hard, yet it is also brittle. These plastics are utilized in frozen food packaging, juice preparation, and milk cartons. There is no break in the contact between the container and the bottled fluid. The usage of type 4 plastic containers for food and beverages is safe since they do not contain any toxic components of the human body. **(Proshad et al., 2018).**

2.1.4. Type 4: Polypropylene

Water, soap, detergent, acid, and bases are all resistant to PP, which boosts its strength and longevity. Because it can endure greater temperatures, it may be used in a variety of applications. During the production process, it can be made transparent, opaque, or a variety of hues. Lunch boxes, butter containers, yogurt pots, sauce bottles, ketchup bottles, plastic bottle tops, and prescription packaging, among other things, are made from it. PP may be recycled into automobile battery boxes, timber, and manhole stairs, among other things. **(Hossain et al., 2021).**

2.1.5. Type 5: Polystyrene

One sort of petroleum-based plastic is polyethylene. The chemical 'benzene' is used in the production of polystyrene, which is a human carcinogen. Polystyrene is frequently utilized in packaging and insulating materials. Styrene is extremely hazardous to one's health. Long-term steroid exposure has been proven to have neurotoxic, hematological, cytogenetic, and carcinogenic consequences, according to studies. Styrene has been designated as a human carcinogen by the International Agency for Research on Cancer (IARC). **(Proshad et al., 2018).**

2.1.6. Type 6: Polyvinyl Chloride

PVC is used to create a variety of pipes, tiles, and electrical components. Due to its diverse features such as lightweight, durability, cost effectiveness, corrosion resistance, and ease of processing, PVC has recently begun to take the place of traditional building materials. It is physiologically and chemically robust since it contains chlorine as a

fundamental element. Recycling programs often do not take PVC plastic. **(Hossain et al., 2021).**

2.2. Plastic packaging

Thousands of plastic manufacturers produce tons of plastic bags, which are widely used for shopping because of their simplicity, low cost, and convenience, but their extremely dangerous negative influence is seldom emphasized or, at the very least, openly addressed in a more serious tone. Many nations, particularly agricultural countries like Bangladesh, India, Pakistan, and South Africa, have banned plastic bags due to popular concern over their substantial detrimental impact on the environment and agriculture. The qualitative research approach was employed in this research article to assess our thoughts based on a literature review and expert interviews. The study focuses on developing alternatives to the usage of ever-harmful plastic bags in order to achieve sustainable agricultural and economic growth. **(Jalil, Mian and Rahman, 2013).** When plastic garbage spills into the ecosystem, it generates a slew of issues. Plastic bags clog up streams and make natural catastrophes worse. Plastic bags can accelerate the transmission of vector-borne illnesses like malaria by blocking drains and creating breeding grounds for mosquitoes and parasites. Hundreds of species have had their airways and stomachs blocked by high amounts of plastic pollutants, notably plastic bags. Turtles and dolphins frequently consume plastic bags, mistaking them for food. **(Giacovelli, 2018).**

2.3. Short- Term Plastic Usability

Cigarette butts, plastic beverage bottles, plastic bottle caps, food wrappers, plastic grocery bags, plastic lids, straws and stirrers, glass beverage bottles, other types of plastic bags, and foam take-away containers are the most common finds during international coastal cleanups, according to a recent report. The majority of the slots in this Top Ten were taken by single-use plastics, and it's easy to believe that the rankings for rubbish discovered inland would be similar. The abundance of single-use plastics in the environment is indicative of weak or failed waste management systems, in addition to people's irresponsibility. **(Giacovelli, 2018).**

2.4. Impact of Single Use Plastic

Conduct a baseline assessment to identify the most problematic single-use plastics, as well as the underlying causes, scope, and implications of their improper disposal. **(Giacovelli, 2018).**

2.4.1. Single-use plastic impact on human body

Human wellbeing dangers from plastics can stem from their monomeric building squares, their added substances or from a combination of the two. There are a few poisonous materials which are emitted by plastics. We focus on plastics components and additional compounds of critical concern, such as Bisphenol A and phthalates, among them. Bisphenol A (BPA) is best known as the monomeric building piece of polycarbonate plastics. It was to begin with synthesized in 1891 and utilized habitually as an added substance to other plastics such as polyvinyl chloride (PVC). **(Proshad et al., 2018).**

2.4.2. Single-use plastic impact on Environment

According to recent data, just around 9% of the approximately 6,300 Mt of garbage created worldwide between 2005 and 2015 was recycled, 12% was burnt, and over 79 percent was sent to landfills or natural environments. Bangladesh is no different from the rest of the world when it comes to the destiny of plastic garbage. Most used plastic items in our county are thrown after their initial use, and they end up in roads, drains, canals, rivers, and roadside open dumps owing to poor management. This is causing damage to the environment day by day. **(Hossain et al., 2021).**

2.4.3. Single-use plastic impact on Agriculture

Plastic bags have a significant detrimental influence on agricultural areas across the world. People are oblivious of the need of recycling plastic bags, so they dump them anywhere as and when they choose. As a result, these wasted plastic bags will inevitably end up in agricultural fields, intermingled with other degraded materials. Because plastic bags do not disintegrate in the soil, they linger on agricultural fields and obstruct the growth of agricultural plants. Plastic bags have the intrinsic quality of preventing crop roots from piercing them in order to travel about the soil in search of natural nutrients,

notwithstanding their thinness. As a result, plastic bags have harmed the growth of agricultural products significantly. Plastic bags have the following detrimental effects on agriculture: decreased soil fertility, decreased nitrogen fixation, massive loss of nutrients in the soil, decreased crop harvest, discrepancy in flora and fauna on the soil, and so on. Plastic bags' negative effects affect soil fertility to a large amount, resulting in a significant reduction in agricultural yield. **(Jalil, Mian and Rahman, 2013).**

2.4.4. Single use-plastic impact on marine ecosystem

Small fish commonly eat plastic pellets, which increases their mortality rates, according to feeding studies using plastic pellets. Floating plastic waste, such as fishing gear, has been discovered to be a navigational hazard, resulting in the death or damage of marine species, clogging water intakes, and interfering with ship propellers. Early studies, in response to increased public awareness of stranded plastic trash on beaches, discovered that the regular retention rate of containers and other different bottles differed across different beaches, and that plastic bottles lasted longer on beaches than non-plastic bottles. **(Issifu and Sumaila, 2020).**

2.5. Single use plastic pollution during covid-19

During the epidemic in Bangladesh, there was an increase in single-use plastic consumption, garbage creation, and related repercussions. In Bangladesh's first month of official lockdown, 14,500 tons of harmful plastic garbage was collected, about twice as much as before the epidemic (7250 tons each month). In Bangladesh, COVID-19-related medical waste is discarded indiscriminately, with much of it carrying the coronavirus. Individual choices during lockdowns are also driving the demand for plastic. Plastic garbage was generated by packaged take-out meals and home-delivered groceries, accounting for 40% of total waste. **(Ali, 2021).**

2.6. Related Study

2.7. Study – 1

The research paper selected for Study-1 is: Using Plastic Bags and Its Damaging Impact on Environment and Agriculture: An Alternative Proposal

2.7.1. Study-1 object

The goals of this article are to first examine the negative impact of plastic bags on agriculture based on a literature analysis, and then to recommend biodegradable and environmentally friendly alternatives to plastic bags. Plastic shopping bags are harmful to agriculture and the environment. **(Jalil, Mian and Rahman, 2013).**

2.7.2. Study-1 result

Plastic bags are wreaking havoc on the environment, particularly agriculture, all over the world. Plastic bags have a negative impact on the ecosystem, including the land, water, and air. Plastic bags are made from fossil fuels, which release toxic gases that are harmful to the planet's many life forms. In non-industrial areas, inconsiderate dumping of plastic bags after use and a lack of adequate management are also wreaking havoc on the environment. Disposing of plastic bags in a careless manner clogs drain systems, contributing to huge floods that have already claimed hundreds of lives and cost billions of dollars to repair the damage and restore public infrastructure. The problem has been exacerbated by the careless dumping of discarded plastic bags on the streets and in open public spaces, resulting in inevitable contamination. Plastic bags are sometimes burned, generating poisonous smoke that is hazardous to one's health, as well as causing the greenhouse effect owing to ozone layer depletion, therefore directly increasing the temperature of the global atmosphere. **(Jalil, Mian and Rahman, 2013).**

2.8. Study-2

The research paper selected for Study-2 is: Plastic pollution in Bangladesh: A review on current status emphasizing the impacts on environment and public health

2.8.1. Study-2 object

The research is based on a careful examination of current literature from a worldwide standpoint. Because of its low weight, great strength, and diverse use, plastics have been widely seen as a gift to contemporary living. They are also less expensive than other materials. Plastics, on the other hand, have grown pervasive in all environmental compartments due to their low biodegradability, overconsumption, and widespread

mismanagement, and are blamed for massive contamination of the air, soil, and water bodies. Bangladesh is no exception to this worldwide trend, albeit there has been some effort to estimate the amount of plastic trash and its consequences, which is required to properly combat this growing problem. **(Haque et al., 2021).** In light of this, the present study looks at the effects of plastic pollution, particularly its most dangerous form, microplastics, on the environment and human health in Bangladesh. In Bangladesh, it has been discovered that a large amount of used plastic is mishandled, posing a serious hazard to the environment and human health. Overall, the goal of this project is to elicit a desire among academics to conduct a complete study of plastic pollution in Bangladesh, as well as a concern among competent authorities to formulate policies and enact essential steps to combat plastic pollution before it is too late. **(Hossain et al., 2021).**

2.8.2. Study-2 result

Because of their low cost, light weight, great durability, and ease of availability, plastic materials are regarded an inextricable part of our everyday life. However, because of their long-term harmful impact on every compartment of the environment - air, soil, and water - they have now become a worldwide hazard. They remain in the environment for an incredibly long period due to their non-biodegradability, move from one compartment to another, and finally become absorbed into the human food chain, posing a serious threat to human health. This work is expected to make the research community realize the importance of conducting a comprehensive study on plastic pollution in Bangladesh, as well as searching for potential eco-friendly alternatives to plastics and assisting policymakers in developing effective policies to reduce plastic pollution. (**Hossain et al., 2021).**

CHAPTER 3: METHODOLOGY

3.1. Study Area

Single-use plastics have been polluted in most parts of Bangladesh by single-use plastics. But more than that, a large number of single-use plastics are deposited in areas where people go for a little recreation like Lake, Park, and Dhaka University Area TSC etc. Looking at these places, we noticed that most of the one-time cups, water bottles, polythene bags etc. are lying around. In this situation, we chose a few public places for the survey data collection: Hatirjheel Area, Chandrima Udyan, Suhrawardy Udyan, Dhanmondi Lake. The reason for selecting these areas is that since these were public places, we had to survey them, so we went to all those places. In all these public areas much more single-use plastic is discharged throughout the day.

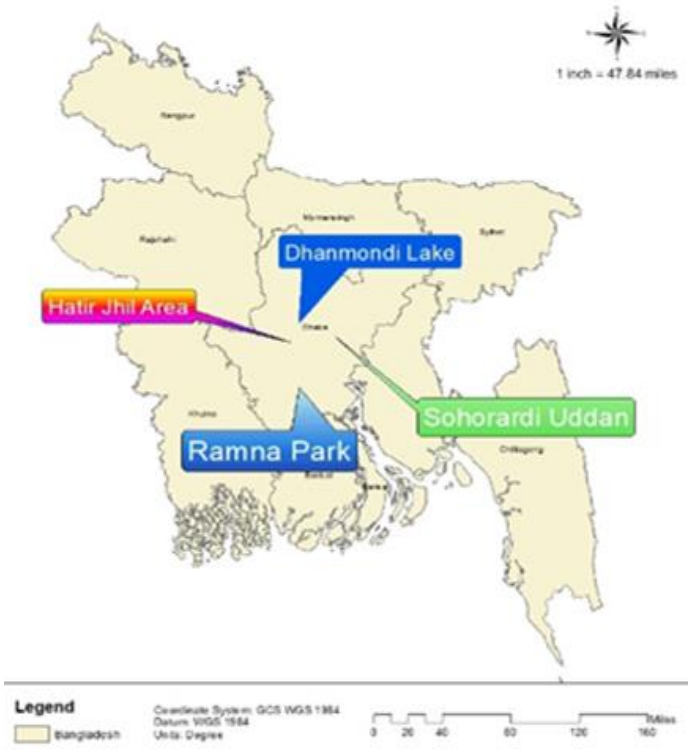


Figure 01: Study area in map

3.2. Survey Data Collection details

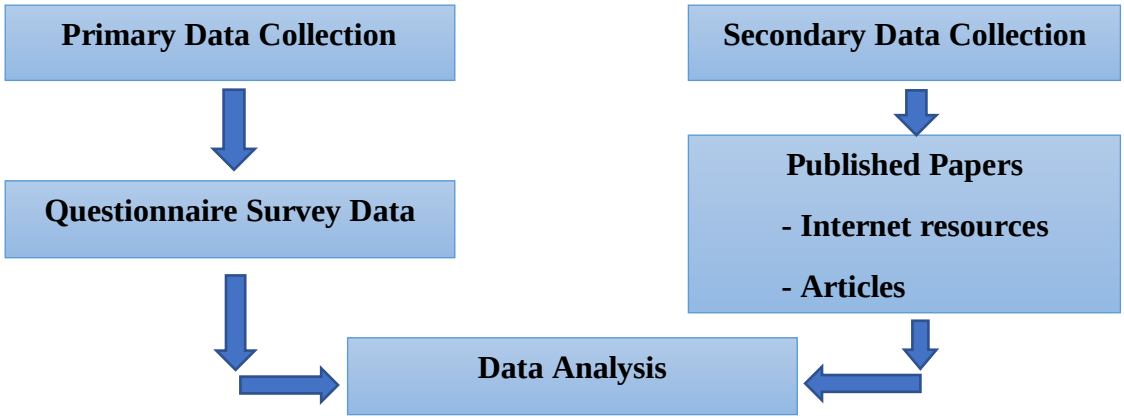


Figure 02: Data analysis chart

3.2.1. Primary data Collection

Survey data primary has been collected from four public places in Dhaka city. Survey data has been collected from one hundred people. The first survey data collection area was Dhanmondi Lake.

Figure 03: Survey Data collection (Dhanmondi Lake, Hatirjheel Lake)

Data was collected from approximately twenty five people from the area. Second, data for the survey was collected from twenty five people from Chandrima Udyan. Thirdly, survey data was collected from Suhrawardy Udyan. While collecting data, I noticed that Suhrawardy Udyan is a beautiful and green place where people can breathe a sigh of relief but there are water bottles, tea cups, packets of chips, polythene lying around. These are all single-use plastics; these plastics are damaging the garden environment and ruining the beauty. If we do not speak out against single plastic, the environment will continue to be polluted and the green environment will lose its life. Hatirjheel Lake Area was the place of last survey data collection. From here also data collection has been done from twenty five people. During the data collection, I noticed that a lot of single-use plastics are being discharged from nearby shops and restaurants and these are causing huge damage to the environment. This plastic takes hundreds of years to decompose. For example, soil is being polluted, water is being polluted, air is being polluted due to burning of plastics, and agricultural fields are being polluted.

Figure 04: Survey Data collection (Suhrawardy Udyan, Chandrima Udyan)

3.2.2. Secondary data Collection

Secondary data from the survey was collected from publicist papers and public articles.

3.3. Data collection place in map

3.3.1. Dhanmondi Lake

The area survey of Rabindra Sarobar in Dhanmondi Lake was selected for data collection. Because the main point of Dhanmondi Lake is Rabindra Sarobar and there are always a lot of people coming and going so the place was fixed. The map shows Rabindra Sarobar from where the survey data was collected. Plastics are charged in almost all parts of Bangladesh and the plastics that are found lying there are causing serious damage to the environment but we should be careful to minimize the damage to the environment.

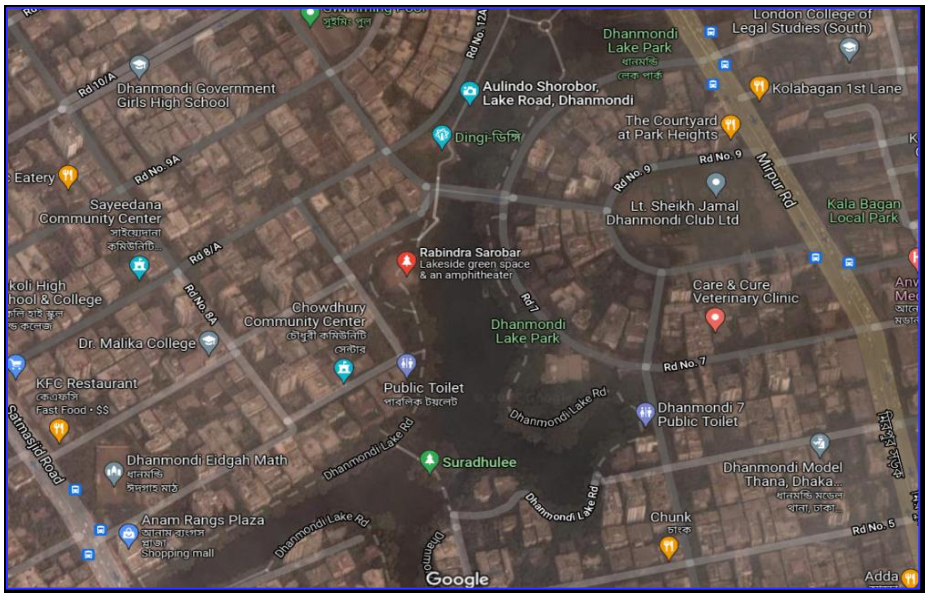


Figure 05: Data collection Location of Dhanmondi Lake

3.3.2. Chandrima Udyan

The areas of Chandrima Udyan from which the survey data were collected are shown on the map. There are some seating areas along Lake Road in Chandrima Udyan where people sit for the recreation. So the survey data were collected along Lake Road. When

the survey data were collected, plastic was found lying on the green grass inside Chandrima Udyan, thus ruining the beauty of the environment.

Figure 06: Data Collection Location of Chandrima Udyan

3.3.3. Suhrawardy Udyan

Suhrawardy Udyan is a big place where people go for walks, play and walk in the afternoon.

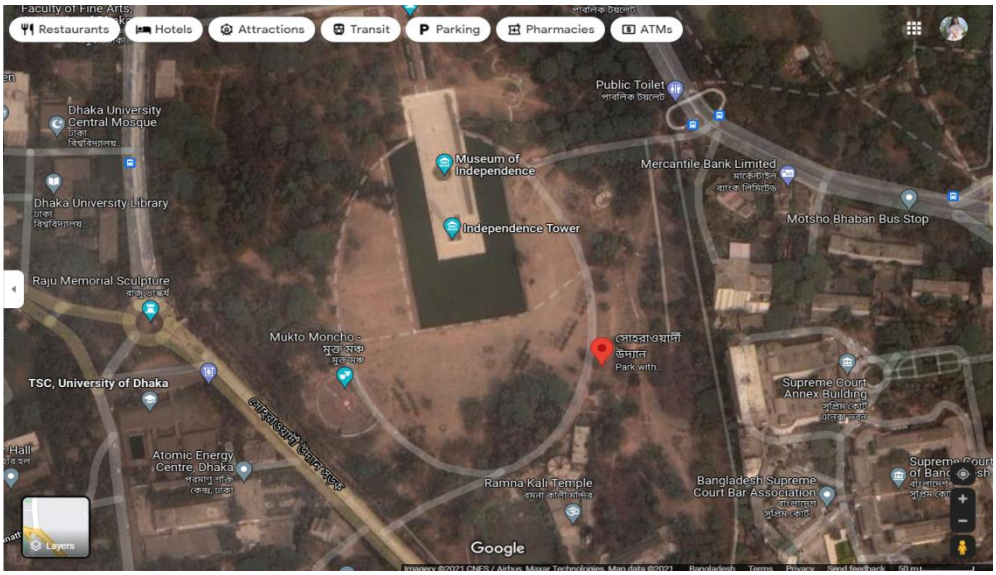


Figure 07: Data Collection Location of Suhrawardy Udyan

There are a lot of people around here all day long. Where there are more people, there is more pollution. Plastic pollution is increasing in Suhrawardy Udyan. Water bottles, polythene, tea cups are always discharged in these areas. None of us are well aware that this single-use plastic is causing serious damage to the environment. We need to work hard to minimize single use plastics.

3.3.4. Hatirjheel Lake Area

Hatirjheel Lake where people go for a little recreation when they have some time. There is no shortage of people in this Hatirjheel area especially during holidays. There is no shortage of single-use plastic discharges. The level of Hatirjheel pollution can be understood by looking at the water. During the data collection, I noticed that a lot of single-use plastics are being discharged from nearby shops and restaurants and these are causing huge damage to the environment. This plastic takes hundreds of years to decompose.

Figure 08: Data Collection Location of Hatirjheel Lake Area

CHAPTER 04: RESULT AND DISCUSSION

This chapter broadly discusses the findings and results of our study in a different form. At the beginning of this research project, we have assumed different objectives and we worked on it. Here, in this chapter, we tried to get a well-organized understanding of the objectives by analyzing the collected data and findings in different ways.

4.1. Study Findings

In this section, we tried to show all our findings and results that we observed from the beginning to the end of this survey study. Here we tried to demonstrate the status of some studies.

4.2. Assume Report

Table 01: Table of Age

How old are you?		
		Percent
Under 15 years	2	2%
15-30 years	87	87%
30- above	11	11%

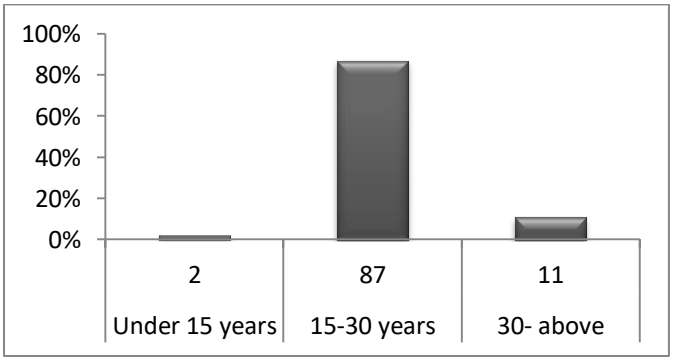


Figure 09: Age column

A physical survey was conducted on single use plastic for this thesis paper. Since it is a survey based thesis paper, data has been collected from 100 people. Personal information question age ratio came in 2% under 15 years, 87% 15 - 30 years and 11% 30 years above.

Table 02: Table of Education

What is your education level?		
		Percent
Primary	1	1%
Higher secondary school	14	14%
Undergraduate	85	85%

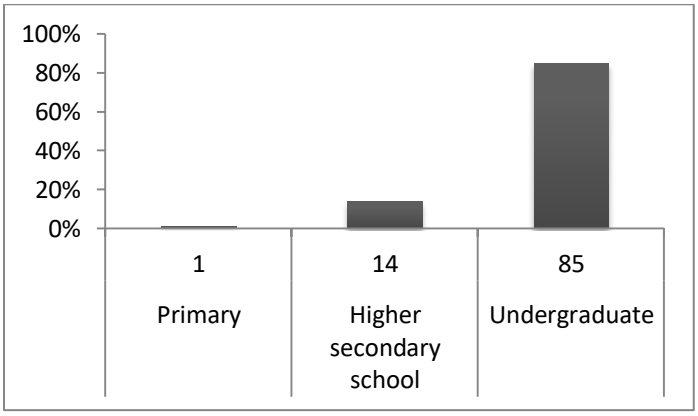


Figure 10: Education Level

A physical survey was conducted on single use plastic for this thesis paper. Since it is a survey based thesis paper, data has been collected from 100 people.

The percentage of education level in Personal Information question was 1% primary, 14% higher secondary school and 85% undergraduate. Since the survey was conducted on single use plastic, our target was to collect data from a fairly educated person.

Table 03: Table of Occupation

What is your occupation?		
		Percent
Student	71	71%
Employee	19	19%
Businessman	10	10%

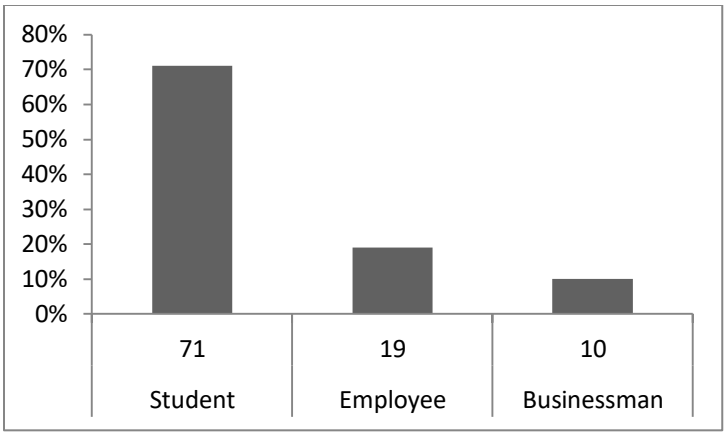


Figure 11: Occupation Level

The percentage of occupation level in Personal Information question was 71% Student, 19% Employee and 10% Businessman. Since the survey was conducted on single use plastic, our target was to collect data from a fairly educated person.

Table 04: Know about single-use plastic

1. Do you know about single-use plastic?		
		Percent
yes	99	99%
No	1	1%

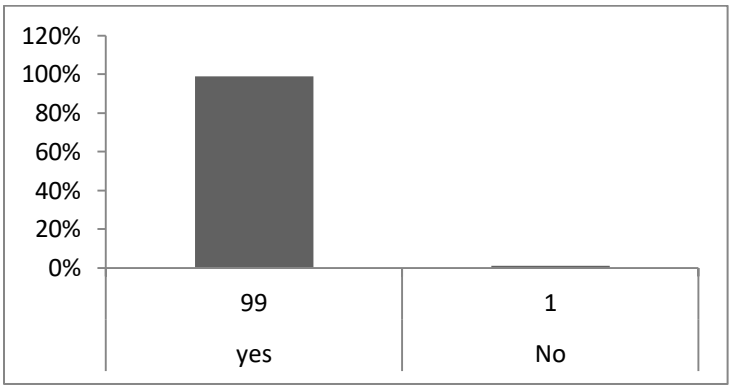


Figure 12: Know about single-use plastic

The percentage ratio in knowing single use plastic survey question is 99% yes and only 1% no. Since the survey was conducted on single use plastics, we collected data from

those who know about single plastics. We do not collect data from people who do not know about single use plastic because they cannot provide exact data.

Table 05: Different kind of plastic use

2. What are some of the things that you frequently use plastic for?		
		Percent
Bags	42	42%
Cups	19	19%
Bottles	38	38%
Other	1	1%

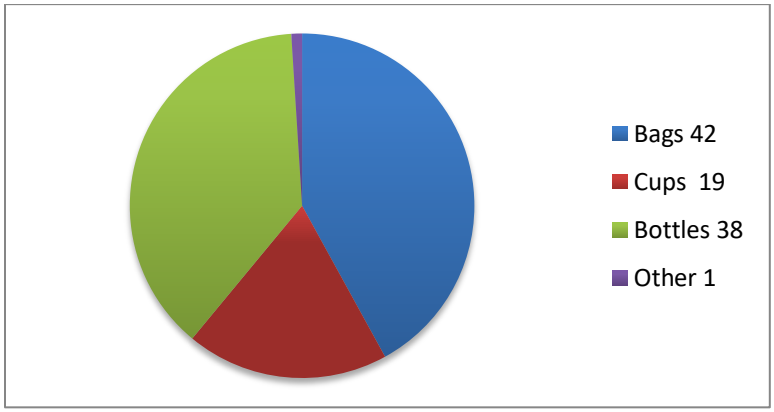


Figure 13: Different kind of plastic use

Different type of single use plastic we frequently use Survey question percentage ratio is 42% bags, 19% cups, 38% bottles and 1% others. Bags, Cups, Bottles Almost all types of single use plastic we use all the time.

Table 06: Surgical mask causes pollution during Covid-19

3. Do you think that using surgical mask causes environmental pollution in this pandemic COVID - 19?		
		Percent
Yes	67	67%
No	33	33%

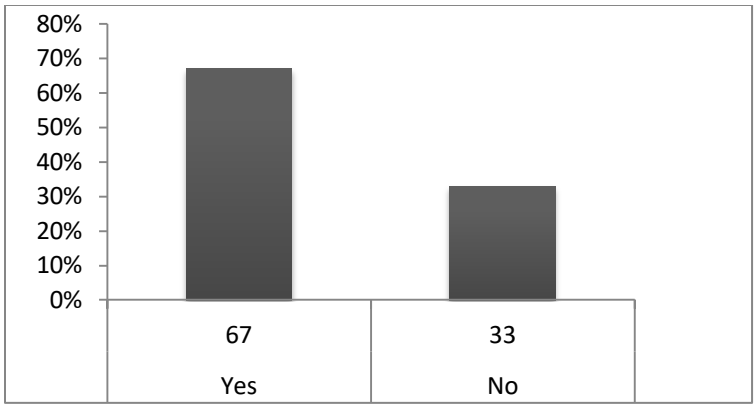


Figure 14: Surgical mask causes pollution during Covid-19

Surgical Mask Causes Pollution during Covid-19 Survey Question Percentage ratio is 67% yes and 33% no. During Covid-19 a large amount of single use plastic discharges such as one time mask, one time gloves, PPE etc.

Table 07: Familiar about the impact of single-use plastics

4. How familiar are you about the impact of single-use plastics on the environment?		
		Percent
Extremely familiar	34	34%
Very familiar	36	36%
Somewhat familiar	13	13%
Not so familiar	17	17%

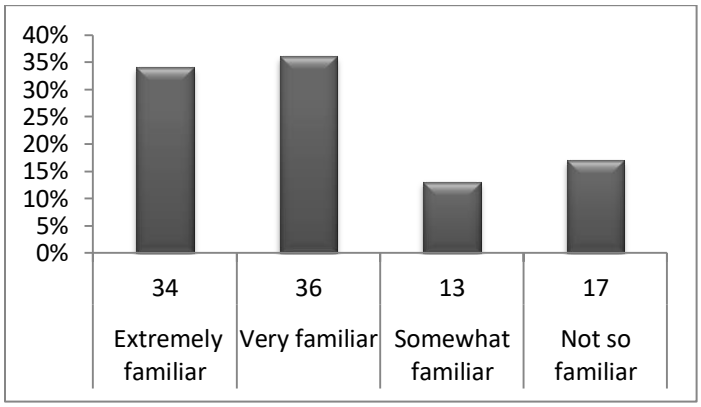


Figure 15: Familiar about the impact of single-use plastics

Familiar about the impact of single-use plastics on the environment the percentage ratio in the survey question is 34% extremely familiar, 36% very familiar, 13% somewhat

familiar and 17% not so familiar. Many are familiar with the impact of single-use plastics and many are not so familiar. We can see here that the higher percentage ratio is familiar but knowing the impact we always use these single-use plastics because the alternative way is not so available in the market.

Table 08: How important to be able to use single-use plastics

5. How important is it to you to be able to use single-use plastics?		
		Percent
A great deal	25	25%
A lot	40	40%
A moderate amount	12	12%
A little	12	12%
None at all	11	11%

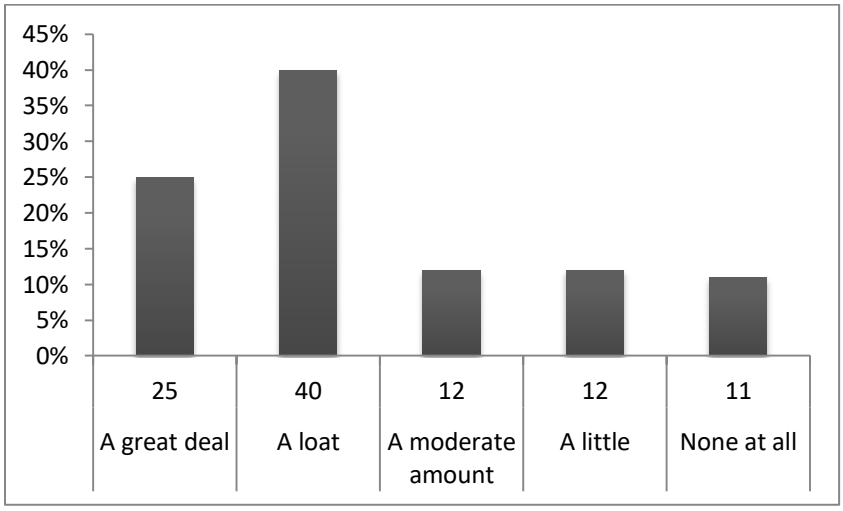


Figure 16: How important to be able to use single-use plastics

How important to be able to use single-use plastics the percentage ratio in the survey question is 25% A great deal, 40% A lot, 12% A moderate amount, 12% A little, and 11% None at all.

Table 09: Avoid using single-use plastics due to their environmental impact

6. How frequently do you avoid using single-use plastics due to their environmental impact?		
		Percent
A great deal	27	27%
A lot	20	20%
A moderate amount	32	32%
A little	18	18%
None at all	3	3%

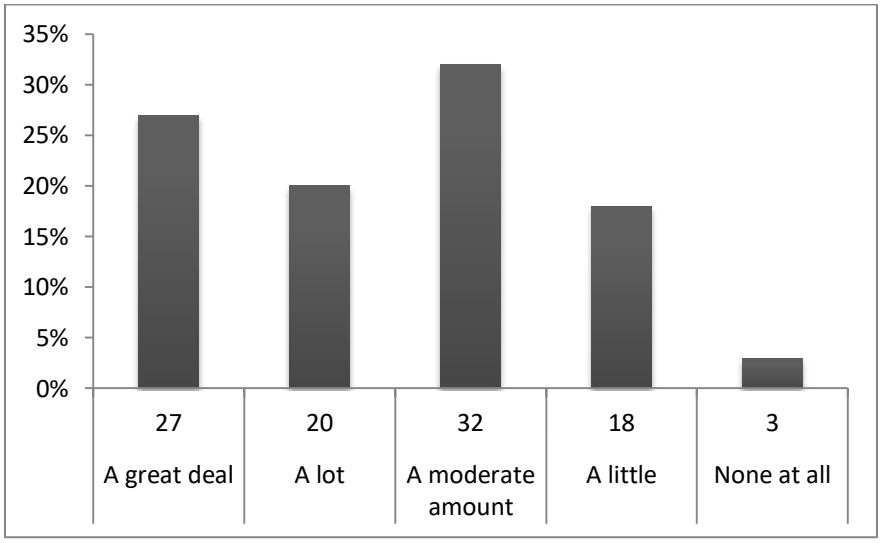


Figure 17: Avoid using single-use plastics due to their environmental impact

Avoid using single-use plastics due to their environmental impact the percentage ratio in the survey question is 27% A great deal, 20% A lot, 32% A moderate amount, 18% A little, and 3% None at all. We never avoid using single use plastic. These single-use plastics are having a huge impact on the environment, harming the human body, damaging agricultural sites, and much more damage that we don't realize.

Table 10: Frequently bring own reusable bags

7. When you go shopping, how frequently do you bring your own reusable bags?		
		Percent
A great deal	15	15%
A lot	16	16%
A moderate amount	35	35%
A little	23	23%
None at all	11	11%

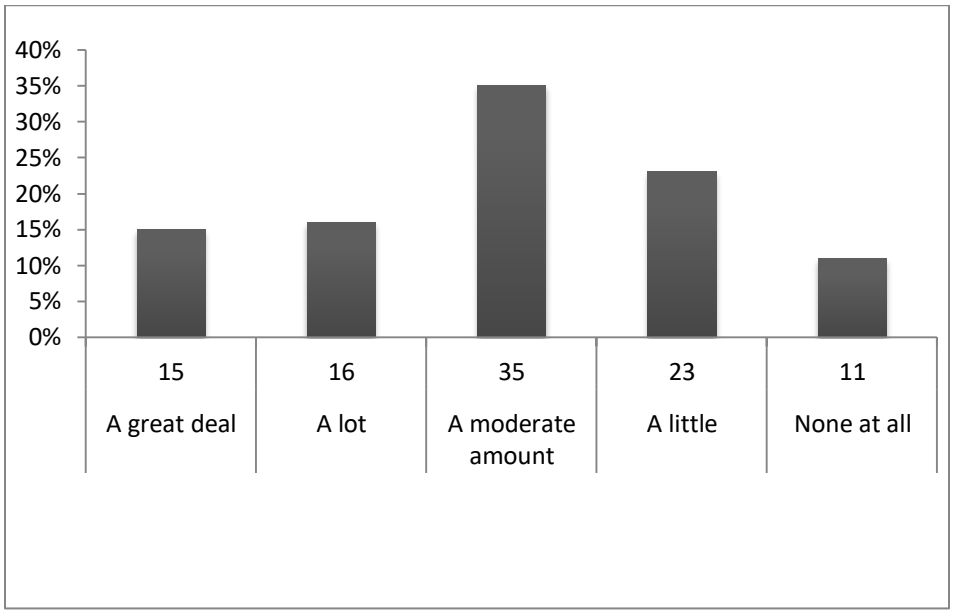


Figure 18: Frequently bring own reusable bags

Frequently bring own reusable bags the percentage ratio in the survey question is 27% A great deal, 20% A lot, 32% A moderate amount, 18% A little, and 3% None at all. We never avoid using single use plastic. We often do shopping while giving us one time bags like polythene bags while shopping. We use these one-time and never re-use them. If we were to re-use these, there would not be so many plastic bags discharged in the environment.

Table 11: Using reusable bags

8. What prevents you from using reusable bags?		
		Percent
Forget to Bring Them	50	50%
Too Expensive	10	10%
Prefer Plastic Bags	5	5%
Prefer Paper Bags	24	24%
Want Paper or Plastic Bags to Use for Other Purposes	11	11%

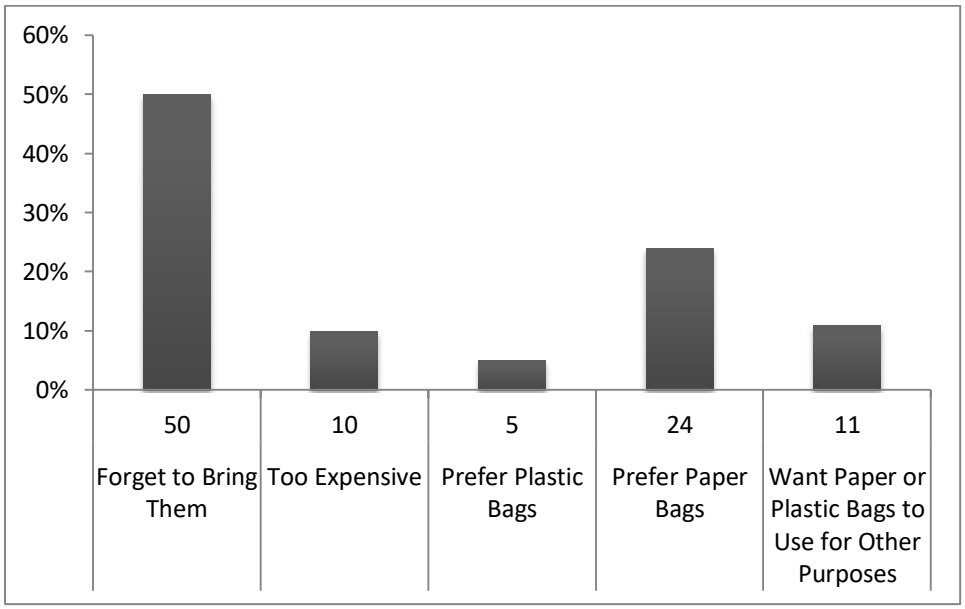


Figure 19: Using reusable bags

What prevents you from using reusable bags? The percentage ratio in the survey question is 50% Forget to bring those, 10% too expensive, 5% Prefer plastic bags, 24% Prefer paper bags and 11% Want paper or plastic bags to use for other purposes. Most of the time we forget to bring our bags. We never avoid using single use plastic. We often do shopping while giving us one time bags like polythene bags while shopping. We use these one-time and never re-use them. If we were to re-use these, there would not be so many plastic bags discharged in the environment.

Table 12: Biggest problem associated with single-use plastics

9. What do you consider to be the biggest problem associated with single-use plastics?		
		Percent
Long Time to Decompose	83	83%
Micro plastics in Waterways	5	5%
Litter in Community	6	6%
Increased Waste in Landfill	2	2%
I Don't Consider it to be a Problem	4	4%

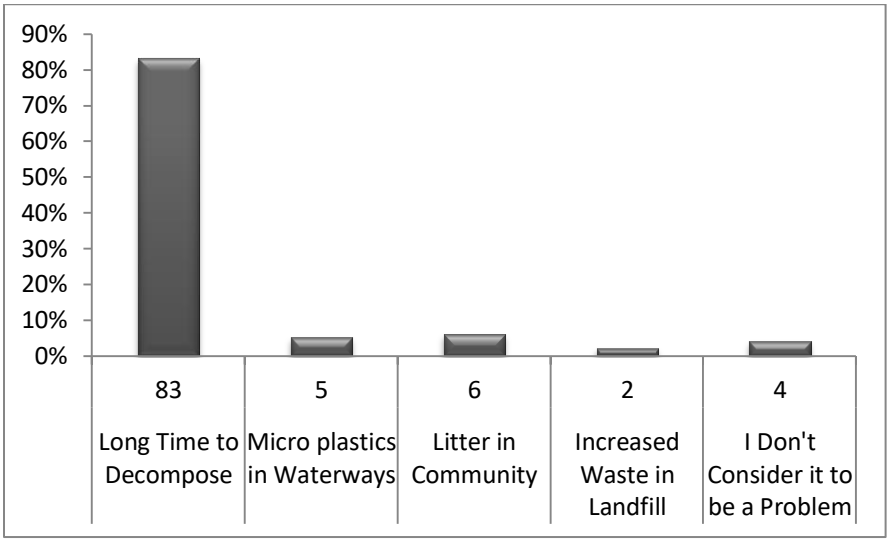


Figure 20: Biggest problem associated with single-use plastics

Biggest problem associated with single-use plastics the percentage ratio in the survey question is 83% Long Time to Decompose, 5% Micro plastics in Waterways, 6% Litter in Community, 2% Increased Waste in Landfill and 4% I Don't Consider it to be a Problem. This is a big problem with long-term de-composite plastics. This problem is destroying soil fertility day by day, causing a lot of damage to the environment, affecting the human body. Plastics usually take hundreds of years to decompose in soil.

Table 13: Towards reducing in our local economy and waste stream

10. Of the following single-use plastics, which do you think your community should take steps towards reducing in our local economy and waste stream?		
		Percent
Plastic Bottles at Events	33	33%
Plastic Shopping Bags	24	24%
Plastic Cups and Lids	21	21%
Plastic Straws	6	6%
I Place Equal Value on Reducing All Single Use Plastics	16	16%

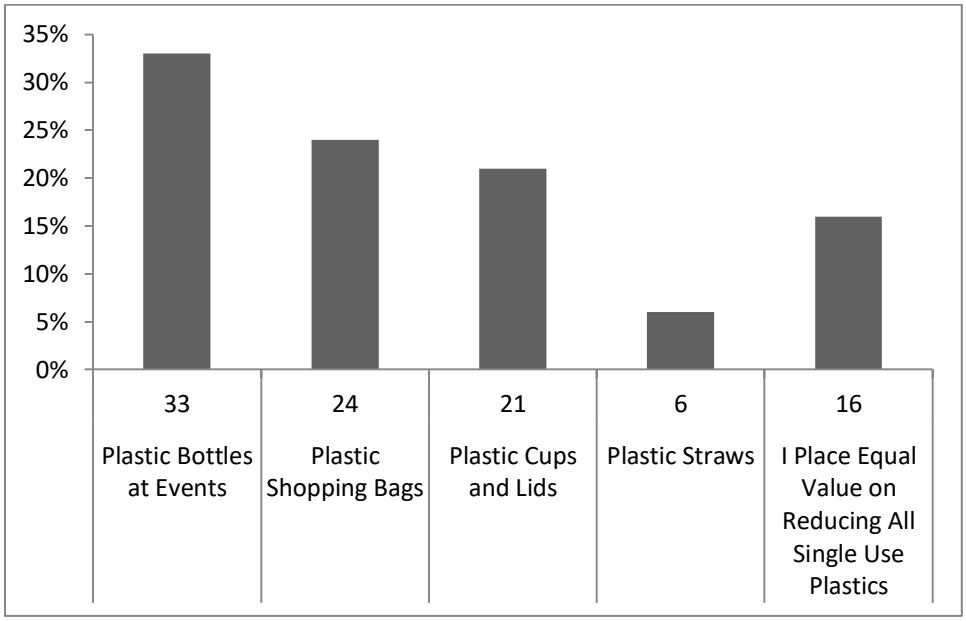


Figure 21: Towards reducing in our local economy and waste stream

Towards reducing in our local economy and waste stream the percentage ratio in the survey question is 33% Plastic bottles at events, 24% Plastic shopping bags, 21% Plastic cups and lids, 6% Plastic straws and 16% I place equal value on reducing all single use plastic. More plastic bottles are discharged from the event and many single-use plastic discharges are also available from different restaurants.

Table 14: Plastic bag ban act

11. Do you support the act plastic bag ban?		
		Percent
Yes	94	94%
No	6	6%

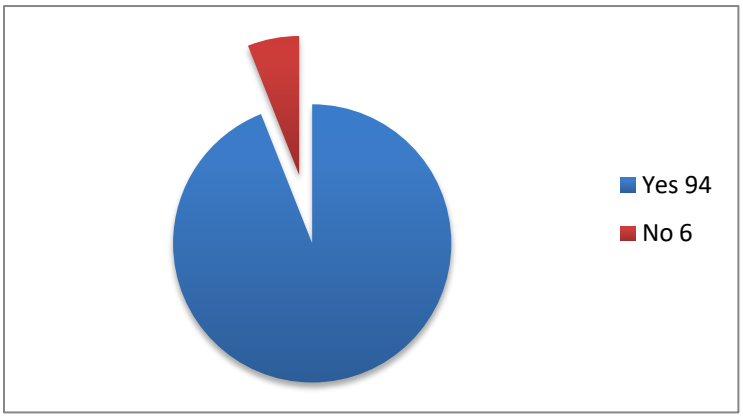


Figure 22: Plastic bag ban act

A physical survey was conducted on single use plastic for this thesis paper. Since it is a survey based thesis paper, data has been collected from 100 people. Plastic bag ban act the percentage ratio in the survey question is 94% yes and 6 % no. Environment needs a strong act to handle single use plastic discharge. This makes it possible to reduce the use of single use plastic.

Table 15: Society has enough information about single-use plastic

12. Do you think that the society has enough information about the dangers of plastic bags?		
		Percent
Yes	26	26%
No	52	52%
Maybe	22	22%

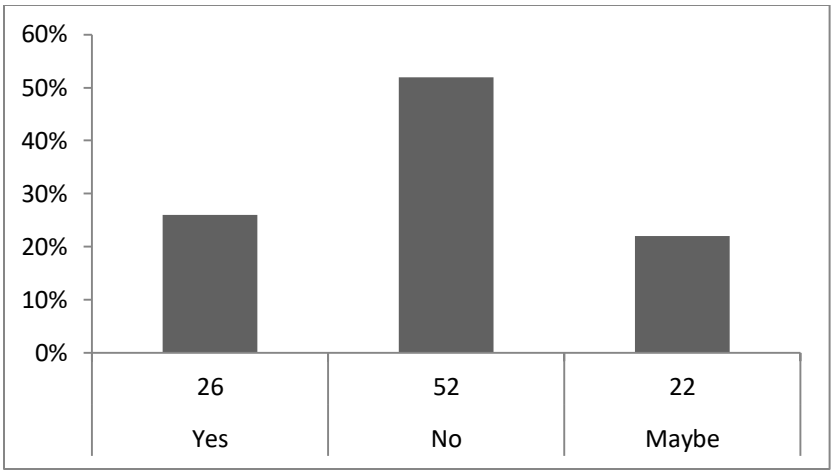


Figure 23: Society has enough information about single-use plastic

Do you think that the society has enough information about the dangers of plastic bags? The percentage ratio in the survey question is 26% Yes, 52% No and 22% Maybe. There is not enough information about plastic pollution in the society, if there was information then so much single use plastic would not be discharged every day. Single-use plastic discharges range from environmental pollution to damage to the human body. Society needs proper information about single-use plastic.

Table 16: Which bag do we currently use?

13. What type of bag do you currently use?		
		Percent
Plastic	51	51%
Paper	35	35%
Reusable	14	14%

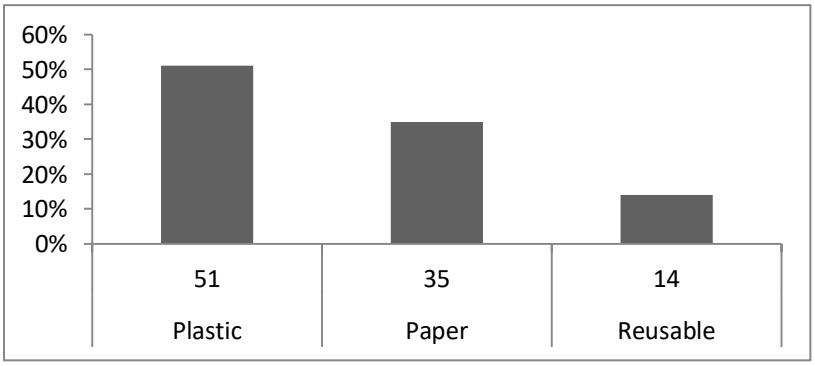


Figure 24: What type of bag do we currently use

What type of bag do you currently use? The percentage ratio in the survey question is 51% Plastic, 35% paper and 14% Reusable. Almost everyone uses plastic bags and throws them away when they are no longer used. Many people use paper bags again but do not reuse them. What happens in the case of plastic bags is that many people throw away plastic bags once they are used but plastic bags do a lot of damage to the environment, plastic bags do not mix so easily. If we re-used the plastic bags, the pollution would be less.

Table 17: Plastic bags banned in all cities

14. Should plastic bags be banned in all cities in country?		
		Percent
Yes	94	94%
No	4	4%

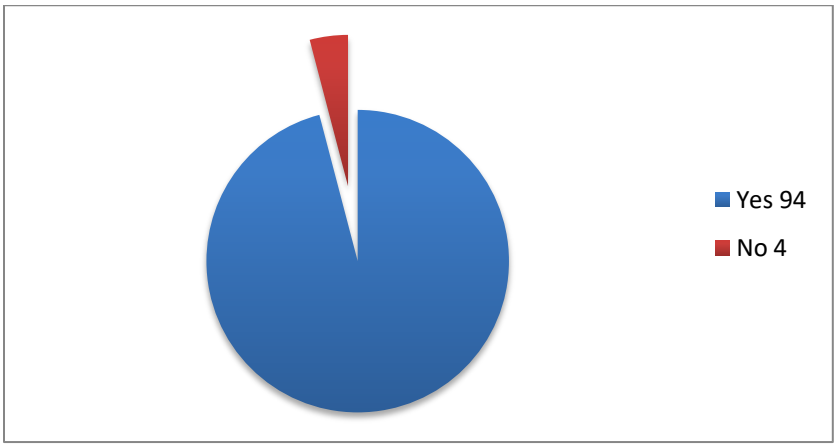


Figure 25: Plastic bags banned in all cities

Plastic bags banned in all cities the percentage ratio in the survey question is 94% Yes and 4% no. Plastic bags should be banned everywhere because plastics do a lot of damage to the environment. If plastic bags are not banned, the damage will increase. Almost everyone uses plastic bags and throws them away when they are no longer used. Many people use paper bags again but do not reuse them. What happens in the case of plastic bags is that many people throw away plastic bags once they are used but plastic bags do a lot of damage to the environment, plastic bags do not mix so easily. If we re-used the plastic bags, the pollution would be less.

Table 18: Ban of plastic bags would improve environmental condition

15. Do you think ban of plastic bags would improve environmental condition?		
		Percent
Yes	85	85%
No	4	4%
Maybe	11	11%

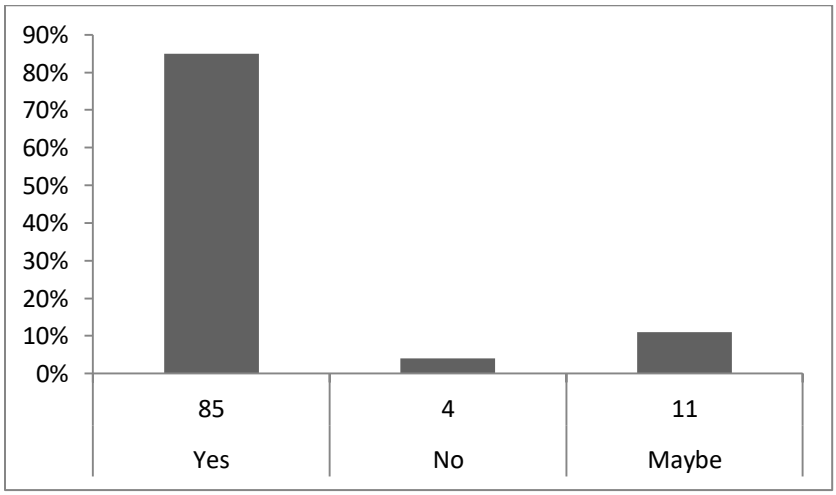


Figure 26: Ban of plastic bags would improve environmental condition

Ban of plastic bags would improve environmental condition the percentage ratio in the survey question is 85% Yes and 4% No and 11% Maybe. Banning plastic bags will improve the environmental condition. Bangladesh will be in even worse shape in the next few years due to the increase in environmental pollution. If the plastic bag is banned then the environmental condition will be better. Plastic bags should be banned everywhere because plastics do a lot of damage to the environment. If plastic bags are not banned, the damage will increase. Almost everyone uses plastic bags and throws them away when they are no longer used. Many people use paper bags again but do not reuse them.

Table 19: Area Covered by plastic (own clarification)

Place	Plastic Type	Pollution ratio (approximate)
Dhanmondi Lake	Bottle, One-time cup, Surgical mask, Chips-chocolate's packet, Straw etc.	70%
Chandrima Udyan	Bottle, One-time cup, Polythene bag, Surgical mask, Chips-chocolate's packet, Straw etc.	90%
Suhrawardy Udyan	Bottle, Polythene bag, Chips-chocolate's packet, Surgical mask, One-time cup, Straw etc.	80%
Hatirjheel Lake	Bottle, One-time plastic food packet, Polythene bag, Chips-chocolate's packet etc.	60%

4.3. Discussion

So, my study area was based on 4 distinct places which is the most Crowed place in Dhaka city. So, from the above table it observes that this 4 places the most amount of plastic type was plastic bottles, polythene, surgical mask, chips-chocolate packets and straws etc.

However, let's discuss from the first study area which was dhanmondi lake so, at this place the people's gathering was very common as this place have so many spaces to move around and for recreation so that it causes medium range of plastic pollution which was about 70%.

After that in the 2nd study area of Chandrima Udyan at this place the people's gathering was huge and it is one of the most crowed area in Dhaka city rather than other areas so that is contains much more higher level of plastic pollution than Shannon's lake which was about 90%.

Then in the 3rd study area was Shaurawdy udyan, at this place the amount of plastic pollution is less than the study area of Chandrima udyan and higher than Dhanmondi Lake which is about 80% as it also seems like the most crowed place in Dhaka city.

After that the 4rth study was Hatirjeel lake, as we all know that this lake was very famous and beautiful for spending time with family and friends so it's a quite a bit clean rather than other areas and it's amount of plastic waste and level was less a bit which is about 60%.

However from my own clarification I found that the surgical mask plastic was the most usage material as I worked for my survey during this pandemic situation. So, among the plastic type the most wasted plastic that I found in every single area was surgical mask.

From my questionnaire survey related to my own clarification the answers of my questioner survey have been matched with my own clarification. Because from my survey data was almost similar to my own clarification plastic type. So that I can easily differentiate between my survey questions answers and my own clarifications.

4.4. Alternative to plastic bag

Jute bags, paper bags, bio-degradable bags, and reusable bags are all environmentally beneficial alternatives to plastic bags. Jute bags are frequently recommended as an environmentally beneficial alternative to plastic bags since they are composed of biodegradable material derived from a plant fiber known as jute, which is largely made up of cellulose. This is environmentally benign and has no negative consequences for the environment or agriculture. As an environmentally friendly alternative to plastic bags, paper bags are also advised. It has been stated that the natural fibers of paper, as well as its recyclability, give paper bags a good image. Biodegradable plastic bags are an alternative to non-biodegradable plastic bags; nevertheless, because they include hazardous ingredients, they are not devoid of environmental impact. As a result, alternatives to plastic bags should be thoroughly evaluated before being used to ensure that they are both soil and environment friendly.

4.5. Biodegradable plastic bag

Plastic businesses are producing biodegradable plastic bags that are less hazardous to the land and environment. Non-biodegradable and biodegradable plastic bags both contain hazardous chemicals and are damaging to the environment. As a result, biodegradable bags that aren't made of plastic are really appreciated. Finding alternatives to plastic bags will need much investigation. The Irish government is also pushing people to use reusable shopping bags, which is commendable because reusable bags would significantly reduce the use of plastic bags and preserve the environment from toxicity.

4.6. Limitation of the study

While doing the thesis, I faced many obstacles. I did not get direct information or papers like this thesis, but I got some related papers and got information from them. And when I went to collect the survey data, I still faced many problems like time was Covid-19; many people did not feel comfortable to answer the survey question. Many have refused direct. Many of them did not even give permission to take pictures during the survey. There are many people in our society who do not know anything about single use plastics. We did not collect data from them because they could not provide exact information.

CHPATER 5: CONCLUSION AND RECOMMENDATIOINS

In this final chapter of the study, I tried to assemble all study points from the literature review, data collection, data analysis, result, and discussions. Here, we also tried to justify the objectives of the study. Recommendations are also given for the researchers in order to better understanding of the future study. This chapter divided into two parts.

5.1. Recommendations

Here, I tried to give certain recommendations that are informative and valuable based on a few facts or criteria. Such as-

Water and drinks should be consumed from a reusable bottle or cup. Instead of using disposable plastic hand gloves, invest in a pair of reusable PVC or neoprene gloves. Choose reusable or biodegradable supermarket bags (such as Jute bags) and repurpose storage containers. Pack food in reusable containers or bags instead of using plastic ware and utensils at home.

Despite the fact that there hasn't been enough research on the amount of plastic waste produced and its fate and impact on Bangladesh's various environmental compartments, we can conclude based on limited regional studies and a large number of global studies that the country is and will continue to be at high risk of plastic pollution unless immediate action is taken. This pollution is hurting all creatures, from humans to zooplankton, by poisoning the whole ecosystem. Furthermore, achieving the United Nations' 2015 sustainable development goal of a poverty-free, pollution-free, peaceful planet Earth by 2030 would be challenging without a curb on plastic manufacturing and appropriate waste management.

- Raising awareness among end users about the negative consequences of plastic use through media advertisements and initiatives by government and non-government organizations.
- Establishment of a reward-based plastic collecting program to encourage people not to litter with plastic garbage.

- Improving collaboration between universities and research institutions to examine the impact of plastic trash in various environmental compartments.
- Increasing research opportunities and funding for biodegradable polymer and commercially viable plastic product alternatives, particularly packaging plastics.
- For industries and enterprises involved in the manufacturing of biodegradable alternatives to plastics, preferential tax treatment, easy bank loans, and duty-free imports of equipment and machineries are available.
- Taking advantage of the country's vast jute production capacity in the manufacture of cost-effective biodegradable alternatives to plastics, as well as offering incentives for such enterprises.
- Supporting the plastic recycling industry rather than the plastic production industry.

5.2. Conclusion

Plastic bags are wreaking havoc on the environment, particularly agriculture, throughout the globe. Plastic bags have a significant negative impact on the ecosystem, including soil, water, and air. Plastic bags are made from fossil fuels, which produce poisonous gases that are harmful to the planet's many living forms. In non-industrial nations, improper management and inconsiderate disposal of plastic bags after usage are also producing environmental problems. Plastic bags thrown out carelessly choke drain systems, resulting in huge floods that have already claimed hundreds of lives and cost billions of dollars to repair. In addition to the expensive cost of plastic bags, they are a concern for local people and national governments in terms of agricultural potential loss and bad effects on the tourism sector. Plastic bags are also a concern for local people's livelihoods and national governments, both in terms of agricultural potential loss and bad effects on the tourism industry, as well as the high expense of cleanup that falls on local and national governments.

Because of their low cost, light weight, great durability, and ease of availability, plastic materials are regarded an inextricable part of our everyday life. However, because of

their long-term harmful impact on every compartment of the environment- air, soil, and water- they have now become a worldwide hazard. They remain in the environment for an incredibly long period due to their non-biodegradability, move from one compartment to another, and finally become absorbed into the human food chain, posing a serious threat to human health. A road map can be created when single-use plastics are prohibited. Changing to more environmentally friendly options might be a viable option. In the meanwhile, to aid in the reduction of plastic pollution, circular thinking and waste management systems might be enhanced.

REFERENCES

Ahmed, S. U. and Gotoh, K. (2005) 'Impact of banning polythene bags on floods of Dhaka City by applying CVM and remote sensing', in *Proceedings. 2005 IEEE International Geoscience and Remote Sensing Symposium, 2005. IGARSS'05.* IEEE, pp. 1471–1474.

Ali, M. A. (2021) '14. Rise in Single-Use Plastic Pollution Amid COVID-19 Pandemic: Bangladesh Perspective', *Journal of Agriculture, Food and Environment (JAFE)| ISSN (Online Version): 2708-5694*, 2(2), pp. 80–84.

Ali, S. *et al.* (2021) 'Strategic analysis of single-use plastic ban policy for environmental sustainability: the case of Pakistan', *Clean Technologies and Environmental Policy*, pp. 1–7.

De, L. C. (2020) 'Single Use Plastics-Its Impact and Sustainability', *Biotica Research Today*, 2(6), pp. 428–431.

Ganguly, S. (2018) 'Plastic pollution and its adverse impact on environment and ecosystem', in *International Conference Recent Trends in Arts, Science, Engineering and Technology*, pp. 15–16.

Giacovelli, C. (2018) 'Single-Use Plastics: A Roadmap for Sustainability (rev. 2)'.

Haque, M. S. *et al.* (2021) 'SARS-CoV-2 pandemic-induced PPE and single-use plastic waste generation scenario', *Waste Management & Research*, p. 0734242X20980828.

Hossain, S. *et al.* (2021) 'Plastic pollution in Bangladesh: A review on current status emphasizing the impacts on environment and public health',

Environmental Engineering Research, 26(6), pp. 210–231.

Issifu, I. and Sumaila, U. R. (2020) 'A Review of the Production, Recycling and Management of Marine Plastic Pollution', *Journal of Marine Science and Engineering*, 8(11), p. 945.

Jalil, M. A., Mian, M. N. and Rahman, M. K. (2013) 'Using plastic bags and its damaging impact on environment and agriculture: An alternative proposal', *International Journal of Learning & Development*, 3(4), pp. 1–14.

Kang, J.-H., Kito, K. and Kondo, F. (2003) 'Factors influencing the migration of bisphenol A from cans', *Journal of food protection*, 66(8), pp. 1444–1447.

Proshad, R. *et al.* (2018) 'Toxic effects of plastic on human health and environment: A consequences of health risk assessment in Bangladesh', *International Journal of Health*, 6(1), pp. 1–5.

Van Rensburg, M. L., S'phumelele, L. N. and Dube, T. (2020) 'The "plastic waste era"; social perceptions towards single-use plastic consumption and impacts on the marine environment in Durban, South Africa', *Applied Geography*, 114, p. 102132.

APPENDIX

Photographs